CLAIMS

WHAT IS CLAIMED IS:

**[0062] 1.** A lamp comprising:

(a) a waveguide having a body of a preselected shape and dimensions, the body comprising at least one dielectric material and having at least one surface determined by a waveguide outer surface, each said material having a dielectric constant greater than approximately 2;

(b) a first microwave probe positioned within and in intimate contact with the body, adapted to couple microwave energy into the body from a microwave source having an output and an input and operating within a frequency range from about 0.5 to about 30 GHz at a preselected frequency and intensity, the probe connected to the source output, said frequency and intensity and said body shape and dimensions selected so that the body resonates in at least one resonant mode having at least one electric field maximum;

(c) the body having at least one lamp chamber depending, respectively, from at least one said waveguide outer surface, each chamber at a location corresponding to an electric field maximum during operation; and

(d) a gas-fill in each chamber which when receiving microwave energy from the resonating body forms a light-emitting plasma.

**[0063] 2.** The lamp of claim 1 wherein each said dielectric material is a solid material.

**[0064] 3.** The lamp of claim **1** wherein each said dielectric material is a liquid material.

**[0065] 4.** The lamp of claim **1** wherein each said dielectric material is selected from the group consisting of solid materials having a dielectric constant greater than approximately 2, and liquid materials having a dielectric constant greater than approximately 2.

**[0066] 5.** The lamp of claim **2** or **3** or **4**, wherein each said dielectric material has a loss tangent less than approximately 0.01.

**[0067] 6.** The lamp of claim **2** or **3** or **4**, wherein each said dielectric material has a thermal shock resistance quantified by a failure temperature greater than approximately 200°C.

**[0068] 7.** The lamp of claim **2** or **3** or **4**, wherein each said dielectric material has a DC breakdown threshold greater than approximately 200 kilovolts/inch.

**[0069] 8.** The lamp of claim **2** or **3** or **4**, wherein each said dielectric material has a coefficient of thermal expansion less than approximately $10^{-5}$/°C.

**[0070] 9.** The lamp of claim **2** or **3** or **4**, wherein the dielectric constant of each said dielectric

material has a zero or slightly negative temperature coefficient.

**[0071] 10.** The lamp of claim **2** or **3** or **4**, wherein each said dielectric material has stoichiometric stability over a temperature range of about -80°C to about 1000°C.

**[0072] 11.** The lamp of claim **2** or **3** or **4**, wherein each said dielectric material has a thermal conductivity of approximately 2 W/mK (watts per milliKelvin).

**[0073] 12.** The lamp of claim **2** or **3** or **4**, wherein at least one waveguide outer surface has an outer coating of a metallic material.

**[0074] 13.** The lamp of claim **12** wherein a plurality of heat-sinking fins are attached to at least one said metallic outer coating.

**[0075] 14.** The lamp of claim **2** or **3** or **4**, wherein the gas-fill in at least one said lamp chamber is contained within a bulb envelope comprising a surrounding wall hermetically coupled to a window covering the chamber, the window substantially transparent to the light emitted by the plasma.

**[0076] 15.** The lamp of claim **14**, wherein at least one bulb envelope comprises at least one

dielectric material having a dielectric constant greater than approximately 2.

**[0077] 16.** The lamp of claim **14**, wherein at least one said bulb envelope is interior to said lamp chamber.

**[0078] 17.** The lamp of claim **14**, wherein a portion of at least one said bulb envelope is exterior to said lamp chamber.

**[0079] 18.** The lamp of claim **16**, wherein at least one said window comprises a focusing lens.

**[0080] 19.** The lamp of claim **17**, wherein at least one said window comprises a focusing lens.

**[0081]** 20. The lamp of claim **2** or **3** or **4**, wherein the gas-fill in at least one said lamp chamber is contained within a discrete bulb disposed therein, the chamber and bulb comprising a bulb cavity, the discrete bulb positioned at an electric field maximum and transparent to the light emitted by the plasma.

**[0082] 21.** The lamp of claim **2** or **3** or **4**, wherein the gas-fill in each said lamp chamber comprises a plasma-forming gas and a light emitter.

[0083] **22.** The lamp of claim **21**, wherein the plasma-forming gas is a noble gas.

[0084] **23.** The lamp of claim **21**, wherein the light emitter is selected from the group consisting of sulfur, selenium, compounds containing sulfur, compounds containing selenium, and metal halides.

[0085] **24.** The lamp of claim **2** or **3** or **4**, wherein light emitted by the plasma is selected from the group consisting of ultraviolet light, visible light, and infrared light.

[0086] **25.** The lamp of claim **2** or **3** or **4**, wherein said operating frequency is in a range from about 0.5 GHz to about 10 GHz.

[0087] **26.** The lamp of claim **2** or **3** or **4**, wherein said body shape is a rectangular prism.

[0088] **27.** The lamp of claim **2** or **3** or **4**, wherein said body shape is a cylindrical prism.

[0089] **28.** The lamp of claim **2** or **3** or **4**, wherein said body shape is a sphere.

[0090] **29.** The lamp of claim **2** or **3** or **4**, wherein the first microwave probe and a lamp chamber are positioned proximate to the same electric field maximum.

**[0091] 30.** The lamp of claim **2** or **3** or **4**, wherein the body resonates in a mode having at least two electric field maxima, and the first microwave probe and at least one lamp chamber are positioned proximate to different electric field maxima.

**[0092] 31.** The lamp of claim **2** or **3** or **4**, wherein said operating frequency and intensity, and said body shape and dimensions are selected so that the body resonates at a high Q-value prior to plasma formation.

**[0093] 32.** The lamp of claim **2** or **3** or **4**, wherein the first microwave probe has a reflectivity closely matching the reduced waveguide reflectivity after plasma formation.

**[0094] 33.** The lamp of claim **2** or **3** or **4**, further comprising a second microwave probe positioned within the body.

**[0095] 34.** The lamp of claim **33**, wherein the first and second microwave probes are each coupled to a separate microwave source.

**[0096] 35.** The lamp of claim **33**, wherein the body resonates in a mode having at least three electric field maxima, and the first microwave probe, the second microwave probe, and at least

one lamp chamber are each positioned proximate to different maxima.

**[0097] 36.** The lamp of claim **35**, wherein:

(a) the first microwave probe, the second microwave probe, and at least one lamp chamber are each positioned proximate to an electric field maximum;

(b) the second microwave probe is connected to the microwave source input and probes the body to instantaneously sample the amplitude and phase of the electric field therein;

(c) the second probe feeds back the sampled amplitude and phase information to the source input; and

(d) the source amplifies the resonant energy within the body and dynamically adjusts the operating frequency to maintain at least one resonant mode within the body, thereby operating the lamp in a dielectric resonant oscillator mode.

**[0098] 37.** A lamp comprising:

(a) a waveguide having a body with a main portion comprising a solid dielectric material of a preselected shape and preselected dimensions, and a body first side;

(b) the body further having a protrusion extending from said first side and terminating in a second side determined by a waveguide outer surface from which depends a lamp chamber into the protrusion;

(c) a microwave probe positioned within and in intimate contact with the body main

portion, adapted to couple microwave energy into the main portion from a microwave source having an output and an input and operating within a frequency range from about 0.5 to about 30 GHz at a preselected frequency and intensity, the probe connected to the source output, said frequency and intensity and said body main portion shape and dimensions selected such that the main portion resonates in at least one resonant mode having at least one electric field maximum; and

(d) a bulb envelope substantially within the cavity, containing a gas-fill which when receiving microwave energy from the resonating body main portion forms a light-emitting plasma.

**[0099] 38.** The lamp of claim **37** wherein the bulb envelope comprises:

(a) a window substantially transparent to the light emitted by the plasma; and

(b) an outer wall hermetically coupled with the window and shaped to direct light towards the window, said wall having a thermal expansion coefficient approximately equal to the thermal expansion coefficient of the window.

**[0100] 39.** The lamp of claim **38** wherein said solid dielectric material is a ceramic.

**[0101] 40.** A lamp comprising:

(a) a waveguide having a body comprising a solid dielectric material of a preselected shape and preselected dimensions, the body having a first side determined by a first waveguide outer surface;

(b) the body having a lamp chamber depending from said waveguide outer surface, the chamber having an aperture circumscribed by a bulb envelope support sealed to said outer surface;

(c) a microwave probe positioned within and in intimate contact with the body, adapted to couple microwave energy into the body from a microwave source having an output and an input and operating within a frequency range from about 0.5 to about 30 GHz at a preselected frequency and intensity, the probe connected to the source output, said frequency and intensity and said body shape and dimensions selected such that the body resonates in at least one resonant mode having at least one electric field maximum; and

(d) a bulb envelope substantially within the lamp chamber and hermetically sealed to the bulb envelope support and separated from the waveguide body by a gap, the bulb envelope containing a gas-fill which when receiving microwave energy from the resonating body main portion forms a light-emitting plasma.

**[0102] 41.** The lamp of claim **40** wherein the bulb envelope comprises:

(a) a window substantially transparent to the light emitted by the plasma; and

(b) a surrounding wall hermetically coupled with the window and shaped to direct light towards the window, said wall having a thermal expansion coefficient approximately equal to the thermal expansion coefficient of the window.

**[0103] 42.** The lamp of claim **41** wherein a vacuum is maintained in the gap.

**[0104] 43.** The lamp of claim **42** wherein said solid dielectric material is a ceramic.

**[0105] 44.** A method for producing light comprising the steps of:

(a) coupling microwave energy characterized by a frequency and intensity into a waveguide having a body of a preselected shape and dimensions, the body comprising at least one dielectric material and having at least one surface determined by a waveguide outer surface from which depends at least one lamp chamber into the body, each said material having a dielectric constant greater than approximately 2, said frequency and intensity and said body shape and dimensions selected such that the body resonates in a least one resonant mode having at least one electric field maximum;

(b) directing resonant microwave energy into the lamp chamber(s), each lamp chamber containing a gas-fill comprising a plasma-forming gas and a light emitter; and

(c) creating a plasma by interacting the resonant energy with the gas-fill, thereby causing emission of light.

**[0106] 45.** The method of claim **44**, further comprising the steps of:

(a) sampling the amplitude and phase of the electric field within the waveguide body; and

(b) adjusting the operating frequency of the microwave source until the sampled electric field is maximized.